10069705 .022502

JC07 Rec'd PCT/PTO 25 FEB 2002

FORM PTO-1390 (REV 11-98) — U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 4299/PCT

US APPLICATION NO (If known, see 37 CFR 1.5): 10/069705 (unknown - to be assigned)

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/07728	09. August 2000 (09.08.00)	25. August 1999 (25.08.99)

TITLE OF INVENTION: Variable Support Structure With a Modular Construction, Consisting of at Least One Collapsible Structural Module

APPLICANT(S) FOR DO/EO/US: Gerhard RUECKERT

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. [x] This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371
3. [x] This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1)
4. [x] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date
5. [x] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is transmitted herewith (required only if not transmitted by the International Bureau)
   b. [x] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [x] A translation of the International Application into English (35 U.S.C. 371(c)(2)), with Trans. Declaration.
7. [x] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau)
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired
   d. [x] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [x] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [x] An Information Disclosure Statement under 37 CFR 1.97 and 1.98, Form PTO-1449, 6 references.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included
13. [x] A FIRST preliminary amendment.
    [x] A SECOND or SUBSEQUENT preliminary amendment
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [x] Other items or information:
    a. return receipt postcard;
    b. Form PTO-2038 (Credit Card Payment Form);
    c. 13 Figs. on 8 sheets of formal drawings;
    d. copy of International Search Report with English Version.
    e. marked-up version of spec. pgs. 1, 5, 6

NOTE: The priority of German Patent Application 199 40 169.1, filed in the Federal Republic of German on August 25, 1999 is claimed under 35 U.S.C. §119.

NOTE: The entire disclosure of PCT International Application PCT/EP00/07728 is incorporated herein by reference.

NOTE: The applicant qualifies for and claims Small Entity Status.

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U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
10/069705 (not known - to be assigned)	PCT/EP00/07728	4299/PCT

	CALCULATIONS PTO USE ONLY	
17. [x] The following fees are submitted:		
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO $920.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO $890.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $760.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) $670.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $96.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$ 0	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	20 - 20 =	0	X $18.00	$ 0	
Independent claims	1 - 3 =	0	X $78.00	$ 0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $260.00	$ 0	
TOTAL OF ABOVE CALCULATIONS =				$ 890.00	
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).				$ 445.00	
SUBTOTAL =				$ 445.00	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$ 0	
TOTAL NATIONAL FEE =				$ 445.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$ 0	
TOTAL FEES ENCLOSED =				$ 445.00	
				Amount to be: refunded	$
				charged	$

a. [x] Form PTO-2038 (Credit Card Payment Form) ~~A check~~ in the amount of $ 445.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed

c. [x] The Commissioner is hereby authorized to charge any deficiency in or ~~any additional~~ fees which may be required, or credit any overpayment to Deposit Account No. 50-0507. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

CUSTOMER NO.: 021553

SIGNATURE

Walter F. Fasse 02/25/02

NAME

36132

REGISTRATION NUMBER

USPS EXPRESS MAIL
EV 059 670 782 US
FEBRUARY 25 2002

DOCKET NO.: 4299/PCT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN THE MATTER OF THE **PCT NATIONAL PHASE PATENT APPLICATION**

OF: Gerhard RUECKERT

USSN: TO BE ASSIGNED - NEW

FILED: February 25, 2002

USPS EXPRESS MAIL
EV 059 670 782 US
FEBRUARY 25 2002

FOR: Deployable Structure With Modular Configuration, Consisting of at Least One Collapsible Module (as amended)

INTERNATIONAL SERIAL NO.: PCT/EP00/07728
INTERNATIONAL FILING DATE: 09. August 2000 (09.08.00)

ASSISTANT COMMISSIONER FOR PATENTS
BOX PCT
WASHINGTON, D. C. 20231

February 25, 2002

SECOND PRELIMINARY AMENDMENT

Dear Sir:

After calculating the filing fee, but before the first examination, please amend the above identified application as follows.

Referring to the Literal Translation of International Application PCT/EP00/07728

In the Specification:

Please delete and replace the heading at **page 1, above line 1,** to read as follows:

TITLE OF THE INVENTION

Please delete and replace the title at **page 1, lines 1 and 2** to read as follows:

Deployable Structure With Modular Configuration, Consisting of at Least One Collapsible Module

Please delete and replace the paragraph at **page 5, line 17 to page 6, line 12** to read as follows:

The at least one joint of the third joint set is connected with at least two joints of the first and/or second joint set, preferably with three, four or all joints of the first and/or second joint set of the support structure cell or module, by a connecting element that transmits essentially only tension forces. These connecting elements conduct the tension forces that arise upon loading of the support structure by a useable payload and/or the self-weight load or dead load, from the joint of the third joint set to the joints of the first and/or second joint set. Preferably, the joint of the third joint set is equidistant to the ones connected to it or to all joints of the first and/or second joint set. The corner joints of the first joint set form a first, for example upper, bounding surface of the support structure and are spaced, generally in the vertical direction, from the associated corner joints of the second joint set which form a second, for example lower, bounding surface of the support structure. The connecting elements which essentially transmit tension forces are fixed,

especially articulately joined, at the respective joints, and are, for example, formed of respectively two parallel extending wires or cables of steel or another suitable material. The at least one joint of the third joint set lies below the lowermost corner joint of the first joint set with which it is connected.

In the Claims:

Please cancel claims 1 to 4.

Claims **5 to 20** have previously been cancelled in applicant's First Preliminary Amendment.

Please enter new claims **21 to 40** as follows.

21. (new) Deployable structure with a modular configuration consisting of at least one collapsible module (91), which is bounded by joints (114, 115, 126, 121) of a first joint set, which are corner joints of the module (91) and lie in a first surface, and by joints (101, 102, 113, 108) of a second joint set, which are corner joints of the module (91) and lie in a second surface, and with at least one joint (109, 122) of a third joint set, which lies outside of the first surface, whereby at least a portion of the joints of the first and second joint set is fixable in its position relative to one another, especially connectable with one another, by a guide mechanism, characterized in

that, one joint (109) of the third joint set is connected with at least two joints (114, 115, 113, 121) of the first and/or second joint set by a connecting element (39, 41, 43, 45) that transmits essentially only tension forces, and is arranged below the lowermost joint (114, 115, 121) of the first joint set with which it is connected, and in that the forces arising upon loading of the structure by a useful working load and/or the self-weight load are transmittable as tension forces away from the joint (109) of the third joint set to the joints (114, 115, 113, 121) of the first and/or second joint set via the connecting element (39, 41, 43, 45) that transmits essentially only tension forces.

22. (new) Structure according to claim 21, characterized in that a joint (122) of the third joint set is connected with at least one joint (101, 102, 113, 108) of the second joint set by a connecting element (40, 42, 44, 46) that transmits tension and compression forces.

23. (new) Structure according to claim 22, characterized in that the at least two joints (114, 115, 113, 121) of the first and/or second joint set and the at least one joint (101, 102, 113, 108) of the second joint set are connected with a common joint of the third joint set.

24. (new) Structure according to claim 22, characterized in that the at least two joints (114, 115, 113, 121) of the

first and/or second joint set are connected with a first joint (109) of the third joint set, and the at least one joint (101, 102, 113, 108) of the second joint set is connected with a second joint (122) of the third joint set, and in that the first joint (109) of the third joint set is connected with the second joint (122) of the third joint set by a connecting element (11) that transmits compression and tension forces.

25. (new) Structure according to claim 21, characterized in that the first and/or the second surface is a plane.

26. (new) Structure according to claim 21, characterized in that all joints (101, 102, 113, 108) of the second joint set, and the joint (109) of the third joint set, which is connected with at least two joints (114, 115, 113, 121) of the first and/or second joint set by a connecting element (39, 41, 43, 45) that transmits essentially only tension forces, lie in one plane.

27. (new) Structure according to claim 22, characterized in that all joints (114, 115, 126, 121) of the first joint set and the joint (122) of the third joint set, which is connected with at least one joint (101, 102, 113, 108) of the second joint set by a connecting element (40, 42, 44, 46) that transmits tension and compression forces, lie in one plane.

28. (new) Structure according to claim 21, characterized in that the guide mechanism comprises guide means, and in that at least one joint (114) of the first joint set of a corner of the module (91) especially arranged on the outer circumference of the structure is connected by the guide means with a joint (102) of the second joint set of a neighboring corner of the module (91) especially arranged on the outer circumference of the structure, and a joint (101) of the second joint set of the corner is connected by the guide means with a joint (115) of the first joint set of the neighboring corner.

29. (new) Structure according to claim 28, characterized in that the guide means comprise connecting elements (15, 16) that transmit tension and compression forces and that are crossed-over and pivotally connected with one another.

30. (new) Structure according to claim 29, characterized in that the connecting elements (16, 32, 17, 20, 34, 21, 24, 36, 25, 28, 38, 29) that transmit tension and compression forces and that lead to supports of the support structure have a greater load capacity, especially a larger diameter, than the remaining connecting elements (15, 31, 18, 19, 33, 22, 23, 35, 26, 27, 37, 30) of the guide means.

31. (new) Structure according to claim 29, characterized in that at least a portion of the connecting elements (15, 16; 17, 18; up to 37, 38), which are pair-wise crossed-over and

pivotally connected with one another and which transmit tension and compression forces, are connected with one another offset from their center in the longitudinal direction.

32. (new) Structure according to claim 21, characterized in that multiple modules (91, 92, 93, 94) are arranged next to one another, and in that neighboring modules comprise common joints.

33. (new) Structure according to claim 21, characterized in that the expansion of the module (91) or the structure (90) is adjustable by an operating arrangement.

34. (new) Structure according to claim 33, characterized in that the operating arrangement comprises expansion and retraction means, especially an expansion cable and a retraction cable, which are guided in the respective joints over deflection means and are preferably fixably operable on a common joint (101).

35. (new) Structure according to claim 34, characterized in that the expansion cable (1) is guided in the respective joints over deflection means, especially deflection rollers or deflection saddles, with at least two different deflection radii.

36. (new) Structure according to claim 34, characterized in that the structure (90) can have a pre-stress applied thereto by means of the operating arrangement, and thereby the structure (90) takes on a prescribable form in a loaded condition.

37. (new) Structure according to claim 21, characterized in that at least a portion of the joints (114 to 121, 126) of the first joint set and/or of the joints (101 to 108, 113) of the second joint set and/or of the joints (109 to 112, 122 to 125) of the third joint set are connectable by a membrane in such a manner so that thereby an at least partially closed outer surface of the first or second surface is formed.

38. (new) Structure according to claim 21, characterized in that at least a portion of the joints (114 to 121, 126) of the first joint set and at least a portion of the joints (122 to 125) of the third joint set are connectable with at least one, preferably triangular, panel element (201 to 216) in such a manner so that thereby an at least partially closed outer surface of the first surface is formed.

39. (new) Structure according to claim 22, characterized in that the connecting elements that transmit tension and compression forces are articulately joined on the respective joints and are especially formed by rods of aluminum.

40. (new) Structure according to claim 21, characterized in that the connecting elements that transmit essentially tension forces are attached, especially articulately joined, on the respective joints, and at least partially are formed by respectively two parallel extending wires or cables of steel.

REMARKS:

1) The specification is a literal translation of the PCT International Application in accordance with the PCT procedures. The Title of the Invention has been amended to better describe the invention using proper terms of art, in comparison to the original literally translated Title. The Specification has been amended at page 6, line 11, in conformance with an Amendment submitted under PCT Article 34 on October 22, 2001 in the PCT International Stage of this application. A marked-up version of the amended portions of the specification is enclosed. Please enter these amendments.

2) New claim 21 is essentially a translation of amended claim 1 that was submitted under PCT Article 34 on October 22, 2001 in the PCT International Stage of this application. New claims 22 to 40 substantially correspond to literally translated original PCT claims 2 to 20, while omitting multiple dependencies. A few streamlining editorial revisions of some of the claim language have been made as well.

3) Examination of the present U. S. National Phase Application is to proceed on the basis of new claims 21 to 40. Any informalities that might remain in the literally translated description and claims will be addressed later during the pendency of this application.

4) Favorable consideration and allowance of claims 21 to 40 are respectfully requested.

Respectfully submitted,

Gerhard RUECKERT
Applicant

By _____
Walter F. Fasse
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FEBRUARY 25 2002

WFF:ar/4299/PCT
Encls.: postcard, marked-up version of spec. pages 1, 5 and 6

DOCKET NO.: 4299/PCT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN THE MATTER OF THE **PCT NATIONAL PHASE PATENT APPLICATION**

OF: Gerhard RUECKERT

USSN: TO BE ASSIGNED - NEW

FILED: February 25, 2002

USPS EXPRESS MAIL
EV 059 670 782 US
FEBRUARY 25 2002

FOR: Deployable Structure With Modular Configuration, Consisting of at Least One Collapsible Module (as amended)

INTERNATIONAL SERIAL NO.: PCT/EP00/07728
INTERNATIONAL FILING DATE: 09. August 2000 (09.08.00)

ASSISTANT COMMISSIONER FOR PATENTS
BOX PCT
WASHINGTON, D. C. 20231

February 25, 2002

FIRST PRELIMINARY AMENDMENT TO MINIMIZE THE FILING FEE

Dear Sir:

In order to minimize the filing fee, please amend the above identified patent application as follows before calculating the filing fee.

Referring to the Literal Translation of International Application PCT/EP00/07728

In the Claims:

Claims **1 to 4** are maintained for calculating the filing fee.

Please cancel claims **5 to 20.**

REMARKS:

After calculating the filing fee, please further enter the accompanying Second Preliminary Amendment which introduces new claims **21 to 40** for examination.

Respectfully submitted,

Gerhard RUECKERT
Applicant

WFF:ar/4299/PCT
Encls.: postcard

By
Walter F. Fasse
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FEBRUARY 25 2002

"MARKED-UP VERSION"

DOCKET NO: 4299/PCT
INVENTOR: Gerhard RUECKERT

LITERAL TRANSLATION OF PCT INTERNATIONAL APPLICATION
PCT/EP00/07728 FILED ON AUGUST 9, 2000

[Variable Support] (Deployable Structure) With [a] Modular (Configuration) [Construction], Consisting of at Least One Collapsible [Structural] Module

The invention relates to a variable or deployable support structure with a modular construction or configuration, consisting of at least one collapsible support structure cell or module according to the preamble of the claim 1.

A support structure of such type is, for example, known from the U. S. 4,580,375. Therein, the at least one joint of the third joint set is connected with the four corner joints of the first joint set by means of four rods, which are articulately connected with one another in the joint of the third joint set. In a corresponding manner, the corner joints of the second joint set are connected by four rods with a further joint of the third joint set. The rods that lead from the one and the further joint of the third joint set to neighboring corner joints of the first and second joint set are crossed-over and pivotally connected with one another, and respectively form an inner scissors arrangement arranged within the support structure module. The neighboring corner joints of the first and second joint set are connected, i.e. fixed in their position relative to each other, with neighboring corner joints of the second or first joint set of a neighboring corner, by a guide mechanism in the form of rods

erection, and disassembly or take-down is minimal, while the freedom in embodying the configuration is great. The structural static characteristics are especially advantageous. Applications for pavilions, tents, dug-out shelters, emergency shelters, erecting and sheathing systems, come into consideration just as applications in the fields of aeronautic and astronautic technology, for example for antennas and masts, in the construction of pieces of furniture or for objects in the field of play and leisure-time activities, such as kites for example. Locationally fixed but temporary applications are, for example, to roof-over sport and recreational facilities, public plazas, terraces, or atrium or interior spaces. Permanent support structures can be very rationally erected by the connection of plural individual stressed or expanded substructures, which in turn again may consist of plural support structure cells or modules, for example by being suspended into place by means of a crane.

The at least one joint of the third joint set is connected with at least two joints of the first and/or second joint set, preferably with three, four or all joints of the first and/or second joint set of the support structure cell or module, by a connecting element that transmits essentially only tension forces. These connecting elements conduct the tension forces that arise upon loading of the support structure by a useable payload and/or the self-weight load or dead load, from the joint of the third joint set to the joints of the first and/or second joint set. Preferably, the joint of the third joint set is equidistant to the ones connected to it or to all joints of the first and/or

second joint set. The corner joints of the first joint set form a first, for example upper, bounding surface of the support structure and are spaced, generally in the vertical direction, from the associated corner joints of the second joint set which form a second, for example lower, bounding surface of the support structure. The connecting elements which essentially transmit tension forces are fixed, especially articulately joined, at the respective joints, and are, for example, formed of respectively two parallel extending wires or cables of steel or another suitable material. The at least one joint of the third joint set [preferably] lies below the lowermost corner joint of the first joint set with which it is connected.

A joint of the third joint set is connected with at least one, preferably with three, four or all of the joints of the second joint set, by a connecting element that transmits compression and tension forces. Preferably, this joint of the third joint set is equidistant to the one connected to it or to all of the joints of the second joint set. The forces arising upon loading of the support structure are transmitted away by this connecting element, essentially as compression forces, to the joints of the second joint set, of which generally a portion rest on a support of the support structure. The connecting elements that transmit tension and compression forces are articulately joined to the respective joints and are especially formed by rods of aluminum or some other suitable material. Basically it pertains that the utilized materials comprise the smallest possible mass with a sufficient load capacity. The joints of the third joint set are

8/pvb

DOCKET NO: 4299/PCT
INVENTOR: Gerhard RUECKERT

LITERAL TRANSLATION OF PCT INTERNATIONAL APPLICATION PCT/EP00/07728 FILED ON AUGUST 9, 2000

Variable Support Structure With a Modular Construction, Consisting of at Least One Collapsible Structural Module

The invention relates to a variable or deployable support structure with a modular construction or configuration, consisting of at least one collapsible support structure cell or module according to the preamble of the claim 1.

A support structure of such type is, for example, known from the U. S. 4,580,375. Therein, the at least one joint of the third joint set is connected with the four corner joints of the first joint set by means of four rods, which are articulately connected with one another in the joint of the third joint set. In a corresponding manner, the corner joints of the second joint set are connected by four rods with a further joint of the third joint set. The rods that lead from the one and the further joint of the third joint set to neighboring corner joints of the first and second joint set are crossed-over and pivotally connected with one another, and respectively form an inner scissors arrangement arranged within the support structure module. The neighboring corner joints of the first and second joint set are connected, i.e. fixed in their position relative to each other, with neighboring corner joints of the second or first joint set of a neighboring corner, by a guide mechanism in the form of rods

that are pair-wise crossed-over and pivotally connected with one another while forming outer scissors arrangements. The formation or embodiment of the inner scissors arrangements is constructively disadvantageous, requires an increased production technology effort, and limits the functionality of the support structure module as well as the forms or configurations that can be formed therewith.

The U. S. 5,230,196 shows a support structure with at least one support structure module, wherein joints of a first joint set are connected with joints of a second joint set via so-called outer rod scissors. The mutually neighboring joints of the first joint set are respectively connected with one another by a steel cable running along the edge of the support structure module. In order to prevent a twisting or tangling of the steel cables into one another, especially in the collapsed condition of the support structure, the steel cables running along the edge of the support structure module are connected approximately at the middle thereof by cable holding means with respectively one rod near the articulated joint point of the outer rod scissors. The mutually diagonally opposed joints of the second joint set of the support structure module are connected with one another via steel cables, whereby no coupling or junction of the steel cables is achieved in the crossing point, and thus, the crossing point does not form a joint of the support structure module.

The DE 196 51 444 A1 shows a structural component made of a truss framework support system with at least one centrally arranged

glass element that encloses a space, in connection with which there are arranged tension elements that are connected with the glass element on opposite sides, whereby the glass element is set under compression, and therewith the typically unutilized support potential of the glass structural material is utilized.

The DE 32 22 475 A1 shows an extendable mast construction with an open frame, which comprises three main support struts or spars, which lie parallel to each other and define three planes when the mast is extended. The struts or spars are formed between two triangle frame elements respectively by two rods, which are connected articulately with one another at their connection location, and which are articulately connected at their other end with a point of a triangle frame element. The pivot joints are arranged in such a manner so that each rod pair pivots in one of the three planes. Thereby, the rods do not protrude into the inner space of the mast construction. This similarly prevents a pivoting of the rods when bending loads of the mast construction arise. Tension wires are arranged between the vertex points of neighboring triangle frame elements, which vertex points are not oriented to each other. These tension wires run in the planes defined by the main support struts or spars. The cables are not connected with one another at their intersection points and thus do not form joints of the mast construction at their crossing point.

The DD 259,651 A1 shows a collapsible or disassembleable, lightweight, spatial framework or support structure, which consists

of two pyramids, of which the peaks are arranged to be slidable in a contrary fashion on a guide piece. The side edges lying between the base surface formed by joints of a first or second joint set and the peak formed by a joint of the third joint set, of each respective pyramid, are compression elements. Tension elements are arranged both between the corner points of the base surface of each respective pyramid as well as between the mutually opposed corner points of the base surfaces of both pyramids.

The problem underlying the invention is to provide a support structure with at least one support structure cell or module, especially a variable or convertible support structure with a cellular or modular construction consisting of at least one support structure cell or module, which overcomes the disadvantages of the prior art. Especially, the support structure shall be constructively and functionally improved as well as being simplified with respect to the fabrication technology thereof, and simultaneously shall make a great variety of configurations possible.

The problem is solved by the support structure defined in the claim 1. Particular types of embodiments of the invention are defined in the dependent claims.

The described invention finds application for mobile as well as locationally fixed, but temporary support structures, as well as for the embodiment of permanent support structures in a segmental manner of construction. The effort for transport, storage,

erection, and disassembly or take-down is minimal, while the freedom in embodying the configuration is great. The structural static characteristics are especially advantageous. Applications for pavilions, tents, dug-out shelters, emergency shelters, erecting and sheathing systems, come into consideration just as applications in the fields of aeronautic and astronautic technology, for example for antennas and masts, in the construction of pieces of furniture or for objects in the field of play and leisure-time activities, such as kites for example. Locationally fixed but temporary applications are, for example, to roof-over sport and recreational facilities, public plazas, terraces, or atrium or interior spaces. Permanent support structures can be very rationally erected by the connection of plural individual stressed or expanded substructures, which in turn again may consist of plural support structure cells or modules, for example by being suspended into place by means of a crane.

The at least one joint of the third joint set is connected with at least two joints of the first and/or second joint set, preferably with three, four or all joints of the first and/or second joint set of the support structure cell or module, by a connecting element that transmits essentially only tension forces. These connecting elements conduct the tension forces that arise upon loading of the support structure by a useable payload and/or the self-weight load or dead load, from the joint of the third joint set to the joints of the first and/or second joint set. Preferably, the joint of the third joint set is equidistant to the ones connected to it or to all joints of the first and/or

second joint set. The corner joints of the first joint set form a first, for example upper, bounding surface of the support structure and are spaced, generally in the vertical direction, from the associated corner joints of the second joint set which form a second, for example lower, bounding surface of the support structure. The connecting elements which essentially transmit tension forces are fixed, especially articulately joined, at the respective joints, and are, for example, formed of respectively two parallel extending wires or cables of steel or another suitable material. The at least one joint of the third joint set preferably lies below the lowermost corner joint of the first joint set with which it is connected.

A joint of the third joint set is connected with at least one, preferably with three, four or all of the joints of the second joint set, by a connecting element that transmits compression and tension forces. Preferably, this joint of the third joint set is equidistant to the one connected to it or to all of the joints of the second joint set. The forces arising upon loading of the support structure are transmitted away by this connecting element, essentially as compression forces, to the joints of the second joint set, of which generally a portion rest on a support of the support structure. The connecting elements that transmit tension and compression forces are articulately joined to the respective joints and are especially formed by rods of aluminum or some other suitable material. Basically it pertains that the utilized materials comprise the smallest possible mass with a sufficient load capacity. The joints of the third joint set are

generally arranged within or on the edge of the cell or module space spanned by the corner joints, preferably in any event within a surface bounded by the corner joints.

The respective joints of the first and second joint set may either be connected with a common joint of the third joint set, or the at least two corner joints of the first and/or second joint set are connected with a first joint of the third joint set and the at least one corner joint of the second joint set is connected with a second joint of the third joint set, whereby preferably the first joint of the third joint set is connected with the second joint of the third joint set by a connecting element that transmits tension and compression forces. Thereby, the forces arising in the interior of a support structure cell or module are transmitted away essentially or exclusively as compression forces onto the corner joints of the second joint set and as tension forces onto the joints of the first joint set.

In a particular embodiment of the invention, the surfaces formed by the joints of the first and second joint set respectively form a plane. Thereby, especially in an extended or deployed condition of the support structure cell or module, all of the joints of the second joint set and the joint of the third joint set, which is connected with at least two joints of the first and/or the second joint set, can lie in one plane, and/or all joints of the first joint set and the joint of the third joint set, which is connected with at least one joint of the second joint set, can lie in one plane. Thereby, there result a constructively and

functionally advantageous, planar, first and/or second, for example upper and lower, bounding surface of the support structure cell or module, or respectively of the support structure. In a corresponding manner, however, these surfaces may also form, for example, at least a portion of a spherical shell or an outer shell surface of a circular cylinder. Planar, one- and two-sided curved support structure cells or modules are combinable to form a support structure with a complex configuration.

A joint of the first joint set of a corner especially arranged at the outer circumference of the support structure is connectable with a joint of the second joint set of a neighboring corner especially arranged on the outer circumference of the support structure, and a joint of the second joint set of the corner is connectable with a joint of the first joint set of the neighboring corner, by elements that are crossed-over and pivotally connected with one another and that transmit tension and compression forces. The outer scissors arrangements of the support structure cell or module, or respectively of the support structure, that are formed thereby, in turn form a guide mechanism, which fixes the position relative to one another of the joints that are connected with one another, and, together with the connections to the joints of the third joint set, form a triangular trussing of the support structure cell or module that is very advantageous in view of structural statics. Alternative guide mechanisms, which guide the corresponding joints in associated control or guide paths, are possible.

Preferably, the connecting elements that transmit tension and compression forces and that lead to the supports of the support structure have a greater load capacity, especially a greater diameter, than the remaining connecting elements of the guide mechanism, because greater forces must be transmitted over these connecting elements. Insofar as the surface spanned by the joints shall be a plane, the connecting elements that are crossed-over and pivotally connected with one another are connected with one another centrally, i.e. in the middle with respect to their lengthwise direction. Insofar as the surface spanned by the joints shall comprise a curvature, the connecting elements that are crossed-over and pivotally connected with one another are connected with one another eccentrically, i.e. away from their middle in the length direction.

The expansion or extension of the support structure is variable, particularly the support structure or the support structure cell or module is collapsible and expandable. The expansion of the support structure is adjustable by an operating arrangement, which comprises expansion means and retraction means, especially an expansion cable and a retraction cable, which are guided over deflecting means in the respective joints, and are preferably fixably operable on a common joint. For example, a motor driven winch can be arranged on the common joint, whereby this winch operates the expansion and retraction of the support structure. The expansion and retraction of the support structure is carried out in a manner free of self-tension, in other words in every desired condition during the expansion and retraction, preferably

only the loads caused by the self-weight load or dead load and, if applicable, a useful payload, arise in the support structure. Moreover, the support structure is preferably subjectable to a pre-stressing by means of the operating arrangement, so that it takes up a prescribable form in a loaded condition. This pre-stressing can be achieved, for example, by clamping of the expansion cable with simultaneously application of a tension force to the retraction cable, and then fixing or clamping of the retraction cable.

The expansion cable is guided in the respective joints over deflection means, for example deflection rollers or deflection saddles, with preferably two different deflection radii. There, where the expansion cable is guided along a connecting element of a scissors arrangement, it extends between the two connecting elements forming the scissors arrangement. Due to the differing deflection radii of the deflecting means, the expansion cable is guided past the scissors joints.

The connecting elements transmitting the tension and compression forces are connected at their ends with the respective joints by pivot joints that are arranged horizontally and perpendicularly to the longitudinal axes of the connecting elements. With the possible eccentric arrangement of the scissors joints, the support structure is embodiable, for example as a spherical shell element, without introducing self-stresses in the course of the expansion and retraction. The connecting elements of the scissors pairs, which are thereby tilted out of the vertical plane,

as well as the connecting elements connected with the joints of the second and third joint set, generally require, at their joint connections located at their beginning and end, a further rotational degree of freedom, which may be provided, for example, by two successive pivot joints with pivot axes that are orthogonal relative to one another.

The joints of the first and/or second joint set, preferably under inclusion of the joints of the third joint set, are connectable with a membrane in such a manner so that an at least partially closed outer surface of the first or second surface is thereby formed. If both the joints of the upper as well as of the lower joint network are connected with a continuous membrane, then there arises a pillow or cushion structure reinforced with an internal skeleton. Thereby, the operating arrangement for varying the expansion of the support structure may be embodied by the pneumatics of the pillow or cushion, alternatively or as a supplement to the expansion cable and the retraction cable. In the collapsed condition, the membrane is preferably folded together in the interior of the support structure.

Especially the joints of the first joint set and the at least one joint of the third joint set, which are connected with the joints of the second joint set by connecting elements that transmit tension and compression forces, can be connected with at least one preferably triangular shaped panel element in such a manner so that an at least partially closed outer surface of the first surface is thereby formed. The loading of the support structure

caused by the mass of the panel elements is compensatable by an over-heightening in the unloaded condition. The panel elements are preferably to be arranged in such a manner so that at least a portion thereof connect the joints of the third joint set of neighboring support structure cells or modules with one another. Due to the composite effect of support structure and panel elements, the support capacity of the support structure is further increased, especially the panel elements function as further connecting elements that transmit tension and compression forces.

Further advantages, features and details of the invention follow from the dependent claims as well as the following description, in which several example embodiments are described in detail with reference to the drawings. Thereby, the features mentioned in the claims and in the description can be essential to the invention, respectively individually by themselves, or in any desired combination.

Fig. 1 shows a support structure consisting of 2 x 2 support structure cells or modules in the collapsed condition;

Fig. 2 shows the support structure of the Fig. 1 in a partially expanded condition;

Fig. 3 shows the support structure in the completely expanded condition;

Fig. 4 shows the connecting elements of the guide mechanism leading to the supports;

Fig. 5 shows the connecting elements that transmit essentially only tension forces;

Fig. 6 shows the extending path of the expansion cable;

Fig. 7 shows the extending path of the retraction cable;

Fig. 8 shows the upper plane spanned by the joints of the first or third joint set;

Fig. 9 shows the lower plane spanned by the joints of the second or third joint set;

Fig. 10 shows a covering of the support structure with triangular shaped panel elements;

Fig. 11 shows an alternative embodiment;

Fig. 12 shows an example of a scissors joint; and

Fig. 13 shows an example of the articulated junction of the connecting elements.

The Fig. 1 shows a support structure 90 consisting of 2 x 2 support structure cells or modules 91, 92, 93, 94 in the col-

lapsed condition, in which the support structure 90 is compact, easy to transport and to store. In this condition, the support structure 90 has the largest expansion in the vertical Z-direction. The expansion in the horizontal X- and Y-directions is minimized. The upper joints 114 to 121 and 126 (Fig. 3) of the first joint set lie in a plane, just as the lower joints 101 to 108 and 113 (Fig. 3) of the second joint set. In the collapsed condition, the joints 109 to 112 and 122 to 125 (Fig. 3) of the third joint set are arranged in the vertical direction between the joints of the first and second joint set and in the center of their respective support structure cell or module. The support structure cell or module 91 in the example embodiment is square in the top plan view, but it could just as well be triangular or polygonal. The support structure can be formed by any desired, also three-dimensional, arrangement of n x m (n, m natural numbers) support structure cells or modules.

The Fig. 2 shows the support structure 90 of the Fig. 1 in a partially expanded condition. The spacing of the joints 114 to 121 and 126 (Fig. 3) of the first joint set, and of the joints 101 to 108 and 113 (Fig. 3) of the second joint set has been reduced in the Z-direction, and has been enlarged in the X- and Y-direction. In the following, as an example, the construction and the kinematics of a support structure module 91 are described. The joints 114, 115, 126 and 121 form the four corner joints of the first joint set of a support structure module 91 that is quadrangular in the top plan view. In registration or alignment herewith, the joints 101, 102, 113 and 108 form the

four corner joints of the second joint set. One joint 109 of the third joint set is connected with the joints 114, 115, 113, 121 of the first and second joint set respectively by two steel cables 39, 41, 43, 45 that extend parallel to one another and that transmit essentially only tension stresses. A further joint 122 of the third joint set, which is equally spaced from the joints 101, 102, 113, 108 of the second joint set, is connected with these by a respective aluminum rod 40, 42, 44, 46 that transmits tension and compression forces. The two joints 109, 122 of the third joint set are connected with one another by an aluminum rod 11 that transmits tension and compression forces and that is oriented vertically in the Z-direction in the illustrated example embodiment. In the illustrated condition, the vertical aluminum rod 11 is located in the center of the space spanned by the support structure module 91.

The support structure modules 92, 93, 94 are constructed in a corresponding manner. Neighboring support structure modules 91, 92, 93, 94 comprise common corner joints. In the illustrated 2 x 2 arrangement of the support structure modules 91 to 94, the central joints 113, 126 are common joints of all of the support structure modules 91 to 94.

In the illustrated embodiment, all joints of the first and second joint set are variably fixed or determined in their position relative to one another in a positively enforced or constrained manner by a guide mechanism in the form of inner and outer scissors arrangements. The inner and outer scissors arrangements

serve to transmit away or to transmit further the forces acting on the joints. The corner joint 114 of the first joint set is connected with the corner joint 102 of the second joint set of a neighboring corner, and the corner joint 101 of the second joint set is connected with the corner joint 115 of the first joint set of the neighboring corner, by aluminum rods 15 or 16 respectively, which are crossed-over and pivotally connected with one another, and which transmit tension and compression forces. The further aluminum rods 17, 18; 19, 20; 21, 22; 23, 24; 25, 26; 27, 28; 29, 30 pair-wise form outer scissors arrangements of the support structure 90 in a corresponding manner. By means of these scissors arrangements, the position of the joints of the first and second joint set relative to one another is variably fixed or determined during the varying of the expansion of the support structure 90.

Moreover, the support structure 90 still further comprises the so-called inner scissors arrangements, which are similarly formed by aluminum rod pairs 31, 32; 33, 34; 35, 36; 37, 38 that are crossed-over and pivotally connected with one another. The scissors joints are respectively arranged in the middle of the rods in the illustrated embodiment. With an eccentric arrangement of the scissors joints in the joints 127 to 138, the support structure is embodiable as a cylindrical or spherical shell while maintaining the general topology and without introducing self-stresses in the course of the expansion or retraction. The rods of the scissors pairs, which are thereby tilted out of the vertical plane, as well as the connecting elements that are connected

with the joints of the second and third joint sets generally require a further rotational degree of freedom at the joint connections at their beginning and end. This further rotational degree of freedom is providable, for example, by two successive pivot joints with rotation axes that are orthogonal to one another. In the realization of a spherical shell, the inner scissors joints on the joints 135 to 138 are preferably omitted, whereby in this case, the connecting elements 31, 33, 35, 37 are embodiable as connecting elements 31', 33', 35', 37' that transmit essentially only tension stresses, for example cables (Fig. 11).

The connecting elements 3 to 6 that transmit essentially only tension stresses are embodied as steel cables and exert tension forces on the joints 102, 104, 106, 108, 113 of the second joint set, which are connected thereto. Connecting elements in the form of aluminum rods are arranged as so-called corner stands 7, 8, 9, 10 in the corners of the support structure 90 on the corner joints 101, 103, 105, 107 of the second joint set, whereby these connecting elements transmit essentially compression forces. In the stressed or spread-out condition of the support structure 90, a contacting abutment exists between the corner stands 7, 8, 9, 10 and the associated corner joints 114, 116, 118, 120 of the first joint set.

The rods of the scissors arrangements and the connecting elements leading to the joints 109 to 112 and 122 to 125 of the third joint set, exclusive of the rods 11, 12, 13, 14, are connected

at their ends with respectively one joint of the first, second or third joint sets, by respectively one pivot joint with a pivot axis that extends horizontally and perpendicularly relative to the longitudinal axis. The two rods of one scissors arrangement are additionally connected at their crossing point with the joints 127 to 138, by respectively one pivot joint with a pivot axis that extends horizontally and perpendicularly to the longitudinal axis. The connecting elements 3 to 6, which transmit essentially only tension forces, are connected at their ends with joints of the second joint set by respectively one pivot joint with a pivot axis that extends horizontally and perpendicularly to the longitudinal axis.

The expansion cable 1 and retraction cable 2 is attached on a joint and extends through the support structure 90 over deflection rollers and/or deflection saddles integrated in the joints, to an exit point out of the support structure 90 which preferably comprises a fixing clamp. In the illustrated example embodiment, the expansion cable 1 is attached on the joint 101 and runs with its segments 1a to 1n over the joints 115-102-126-113-119-106-118-104-117-113-126-108 and 121 back to the joint 101 and is there guided out of the support structure 90, as shown in the Fig. 6. The retraction cable 2 is similarly attached on the joint 101, and runs with its segments 2a to 2d over the joints 103-105 and 107 back to the joint 101 and is there similarly guided out of the support structure 90, as shown in the Fig. 7.

For the adjustable variation of the support structure 90, in the opened condition of the clamps, the portion of the expansion cable 1 or respectively the retraction cable 2 located in the support structure 90 is varied by means of a winch respectively connected with the loose end of the cables. With a shortening of the expansion cable 1, and with a simultaneous lengthening of the retraction cable 2, the support structure is extended or expanded. Insofar as the cables 39, 41, ..., 69 connected with the joints 109 to 112 of the third joint set are installed in a shortened state with respect to the geometry in the opened stressed condition, they are stretched or elongated by the expansion of the support structure 90. This achieves a pre-stressing of the connecting elements connected with the joints 109 to 112 and 122 to 125 of the third joint set, which is advantageous with respect to the structural statics. In a corresponding manner, with a shortening of the retraction cable 2 and simultaneous lengthening of the expansion cable 1, the structure is collapsed or retracted. If the retraction cable 2 is set under tensile stress or retracted in the expanded condition, and with a clamped condition of the expansion cable 1, thereby the support structure 90 is pre-stressed, especially to be convexly over-heightened in the illustrated example embodiment. Thereby, the support structure 90 can be adjusted or re-adjusted corresponding to the useable payload that is to be taken up or respectively corresponding to the allowable deformations, already during the expansion or during the later use thereof.

The Fig. 3 shows the support structure 90 in the fully expanded condition. The joint 101 is thereby connected with a rigid or fixed support (not shown) of the support structure 90, while the joints 103, 105, 107 rest on slide bearings (not shown). In the completely expanded condition, all joints 114 to 121 and 126 of the first joint set, as well as the joints 122 to 125 of the third joint set connected with the joints of the second joint set lie in a first upper plane. Correspondingly, all joints 101 to 108 and 113 of the second joint set and the joints 109 to 112 of the third joint set connected with the joints of the first joint set lie in a second plane, which extends parallel to the first plane and is arranged below the first plane.

The Fig. 4 shows the connecting elements 16, 17, 20, 21, 24, 25, 28, 29, 32, 34, 36, 38 of the outer and inner scissors arrangements leading to the supports. These have a higher load capacity, especially a larger cross-section, than the connecting elements crossed-over and pivotally connected therewith.

The Fig. 5 shows the connecting elements 3 to 6 and 39, 41, ..., 69 that transmit essentially only tension forces. Thereby, the connecting elements 39, 41, ..., 69 connected with the joints 109 to 112 of the third joint set are embodied as two-part divided steel cables, through which the connecting elements 40, 42, ..., 70 are guided, whereby the connecting elements 40, 42, ..., 70 transmit tension and compression forces and cross these steel cables.

Upon omitting the corner stands 7 to 10 and integrating the cables 39, 41, ..., 69 forming the connecting elements that transmit essentially only tension forces into retraction and/or expansion cables, the support structure is stiffenable continuously, that is to say in every condition between the fully expanded and fully collapsed conditions, in a planar as well as in a one-fold and two-fold curved form, by a variation of the lengths of the portions of the retraction and expansion cables located in the support structure.

The Fig. 8 shows the upper plane that is spanned by the joints 114 to 126 of the first or the third joint set, whereas the Fig. 9 shows the lower plane spanned by the joints 101 to 113 of the second or third joint set.

The Fig. 10 shows a covering of the completely expanded support structure 90 with triangular shaped panel elements 201 to 216. These respectively support themselves on three joints of the first or third joint set. The flexing of the support structure 90 caused by the mass of these panel elements can be compensated by the above described pre-stressing or over-heightening. In an advantageous manner, the panel elements 202, 205, 208, 211 and 213 to 216 respectively connect the joints 122, 123; 123, 124; 124, 125; 125, 122 of the third joint set of neighboring support structure modules 91 to 94, and especially function as further connecting elements that transmit tension and compression forces.

The Fig. 11 shows an alternative embodiment of a 2 x 2 arrangement of support structure modules in a support structure, which comprises a curvature in X- and Y-direction, which is made possible, among other things, by disassembly of the inner scissors arrangements and by replacement of the connecting elements 31, 33, 35, 37 which transmit tension and compression forces by the cables 31', 33', 35', 37' which transmit essentially only tension forces. Insofar as the support structure is to be curved on only one side, such a disassembly of the inner scissors arrangements is not necessary.

The Fig. 12 shows, as an example, a scissors joint, by which the two connecting elements 15, 16, which transmit tension and compression forces, are crossed-over and pivotally connected with one another. In this context, as can be seen in the Fig. 3, the rod 16 leads to the joint 101 on the support point of the support structure 90 and therefore comprises a larger diameter. The expansion cable 1 is guided through between the rods 15, 16. Thereby, due to the different diameters of the deflecting means arranged in the joints 101, 115, the expansion cable 1 is guided past the joint body 127' of the joint 127 or at least lies in contact thereon without a deflection force that would disadvantageously load the support structure.

The Fig. 13 shows, as an example, the articulate joining of the connecting elements on the common joints 104, 117 of the neighboring support structure modules 92, 93. The rods 19, 20; 21, 22 of the outer scissors arrangements as well as the rods 33, 34

of the inner scissors arrangement and the inner struts 42, 58 are articulately connected on the joints 104 or 117 respectively with a respective joint comprising a rotational degree of freedom. In the illustrated arrangement of rod connections, the moments introduced from the connecting elements onto the joints and horizontal force components mutually cancel each other to a great extent. The cables 51 or 57, which lead to the joints of the third joint set, are embodied in a doubled manner, and respectively receive between themselves the inner strut 52 or 58 in a crossing manner, are similarly articulately connected on the joint 117 with a rotational degree of freedom. The expansion cable 1 extends nearly parallel to the rod 22, coming from the joint 118 around the deflection roller 1' with larger diameter that is articulately connected on the joint 104, to the deflection roller 1" with smaller diameter that is articulately connected on the joint 117, and further nearly parallel to the rod 33 to the joint 113.

Patent Claims:

1. Variable support structure with a modular construction consisting of at least one collapsible support structure module (91), which is bounded by joints (114, 115, 126, 121) of a first joint set, which are corner joints of the support structure module (91) and lie in a first surface, and by joints (101, 102, 113, 108) of a second joint set, which are corner joints of the support structure module (91) and lie in a second surface, and with at least one joint (109, 122) of a third joint set, which lies outside of the first surface, whereby at least a portion of the joints of the first and second joint set is fixable in its position relative to one another, especially connectable with one another, by a guide mechanism, characterized in that, one joint (109) of the third joint set is connected with at least two joints (114, 115, 113, 121) of the first and/or second joint set by a connecting element (39, 41, 43, 45) that transmits essentially only tension forces.

2. Support structure according to claim 1, characterized in that a joint (122) of the third joint set is connected with at least one joint (101, 102, 113, 108) of the second joint set by a connecting element (40, 42, 44, 46) that transmits tension and compression forces.

3. Support structure according to claim 2, characterized in that the at least two joints (114, 115, 113, 121) of the

first and/or second joint set and the at least one joint (101, 102, 113, 108) of the second joint set are connected with a common joint of the third joint set.

4. Support structure according to claim 2, characterized in that the at least two joints (114, 115, 113, 121) of the first and/or second joint set are connected with a first joint (109) of the third joint set, and the at least one joint (101, 102, 113, 108) of the second joint set is connected with a second joint (122) of the third joint set, and in that the first joint (109) of the third joint set is connected with the second joint (122) of the third joint set by a connecting element (11) that transmits compression and tension forces.

5. Support structure according to one of the claims 1 to 4, characterized in that the first and/or the second surface is a plane.

6. Support structure according to one of the claims 1 to 5, characterized in that all joints (101, 102, 113, 108) of the second joint set, and the joint (109) of the third joint set, which is connected with at least two joints (114, 115, 113, 121) of the first and/or second joint set by a connecting element (39, 41, 43, 45) that transmits essentially only tension forces, lie in one plane.

7. Support structure according to one of the claims 2 to 6, characterized in that all joints (114, 115, 126, 121) of the first joint set and the joint (122) of the third joint set, which is connected with at least one joint (101, 102, 113, 108) of the second joint set by a connecting element (40, 42, 44, 46) that transmits tension and compression forces, lie in one plane.

8. Support structure according to one of the claims 1 to 7, characterized in that the guide mechanism comprises guide means, and in that at least one joint (114) of the first joint set of a corner of the support structure module (91) especially arranged on the outer circumference of the support structure is connected by the guide means with a joint (102) of the second joint set of a neighboring corner of the support structure module (91) especially arranged on the outer circumference of the support structure, and a joint (101) of the second joint set of the corner is connected by the guide means with a joint (115) of the first joint set of the neighboring corner.

9. Support structure according to claim 8, characterized in that the guide means comprise connecting elements (15, 16) that transmit tension and compression forces and that are crossed-over and pivotally connected with one another.

10. Support structure according to claim 8 or 9, characterized in that the connecting elements (16, 32, 17, 20, 34, 21,

24, 36, 25, 28, 38, 29) that transmit tension and compression forces and that lead to supports of the support structure have a greater load capacity, especially a larger diameter, than the remaining connecting elements (15, 31, 18, 19, 33, 22, 23, 35, 26, 27, 37, 30) of the guide means.

11. Support structure according to claim 9 or 10, characterized in that at least a portion of the connecting elements (15, 16; 17, 18; up to 37, 38), which are pair-wise crossed-over and pivotally connected with one another and which transmit tension and compression forces, are connected with one another outside of their middle in the longitudinal direction.

12. Support structure according to one of the claims 1 to 11, characterized in that plural support structure modules (91, 92, 93, 94) are arranged next to one another, and in that neighboring support structure modules comprise common joints.

13. Support structure according to one of the claims 1 to 12, characterized in that the expansion of the support structure module (91) or the support structure (90) is adjustable by an operating arrangement.

14. Support structure according to claim 13, characterized in that the operating arrangement comprises expansion and retraction means, especially an expansion cable and a

retraction cable, which are guided in the respective joints over deflection means and are preferably fixably operable on a common joint (101).

15. Support structure according to claim 14, characterized in that the expansion cable (1) is guided in the respective joints over deflection means, especially deflection rollers or deflection saddles, with at least two different deflection radii.

16. Support structure according to claim 14 or 15, characterized in that the support structure (90) can have a pre-stress applied thereto by means of the operating arrangement, and thereby the support structure (90) takes on a prescribable form in a loaded condition.

17. Support structure according to one of the claims 1 to 16, characterized in that at least a portion of the joints (114 to 121, 126) of the first joint set and/or of the joints (101 to 108, 113) of the second joint set and/or of the joints (109 to 112, 122 to 125) of the third joint set are connectable by a membrane in such a manner so that thereby an at least partially closed outer surface of the first or second surface is formed.

18. Support structure according to one of the claims 1 to 17, characterized in that at least a portion of the joints (114 to 121, 126) of the first joint set and at least a portion

of the joints (122 to 125) of the third joint set are connectable with at least one, preferably triangular, panel element (201 to 216) in such a manner so that thereby an at least partially closed outer surface of the first surface is formed.

19. Support structure according to one of the claims 1 to 18, characterized in that the connecting elements that transmit tension and compression forces are articulately joined on the respective joints and are especially formed by rods of aluminum.

20. Support structure according to one of the claims 1 to 19, characterized in that the connecting elements that transmit essentially tension forces are attached, especially articulately joined, on the respective joints, and at least partially are formed by respectively two parallel extending wires or cables of steel.

ABSTRACT

Support structure with at least one support structure cell or module, especially variable support structure with cellular or modular construction. The invention relates to a support structure with at least one support structure module (91), especially a variable support structure with modular construction consisting of at least one support structure module, which is bounded by joints (114, 115, 126, 121) of a first joint set that lie in a first surface, and by joints (101, 102, 113, 108) of a second joint set that lie in a second surface, and with at least one joint (109) of a third joint set that lies outside of the first surface, whereby at least a portion of the joints of the first and second joint set is fixable in its position relative to one another, especially connectable with one another, by a guide mechanism, characterized in that, the at least one joint (109) of the third joint set is connected with at least two joints (114, 115, 113, 121) of the first and/or second joint set by a connecting element (39, 41, 43, 45) that transmits essentially only tension forces.

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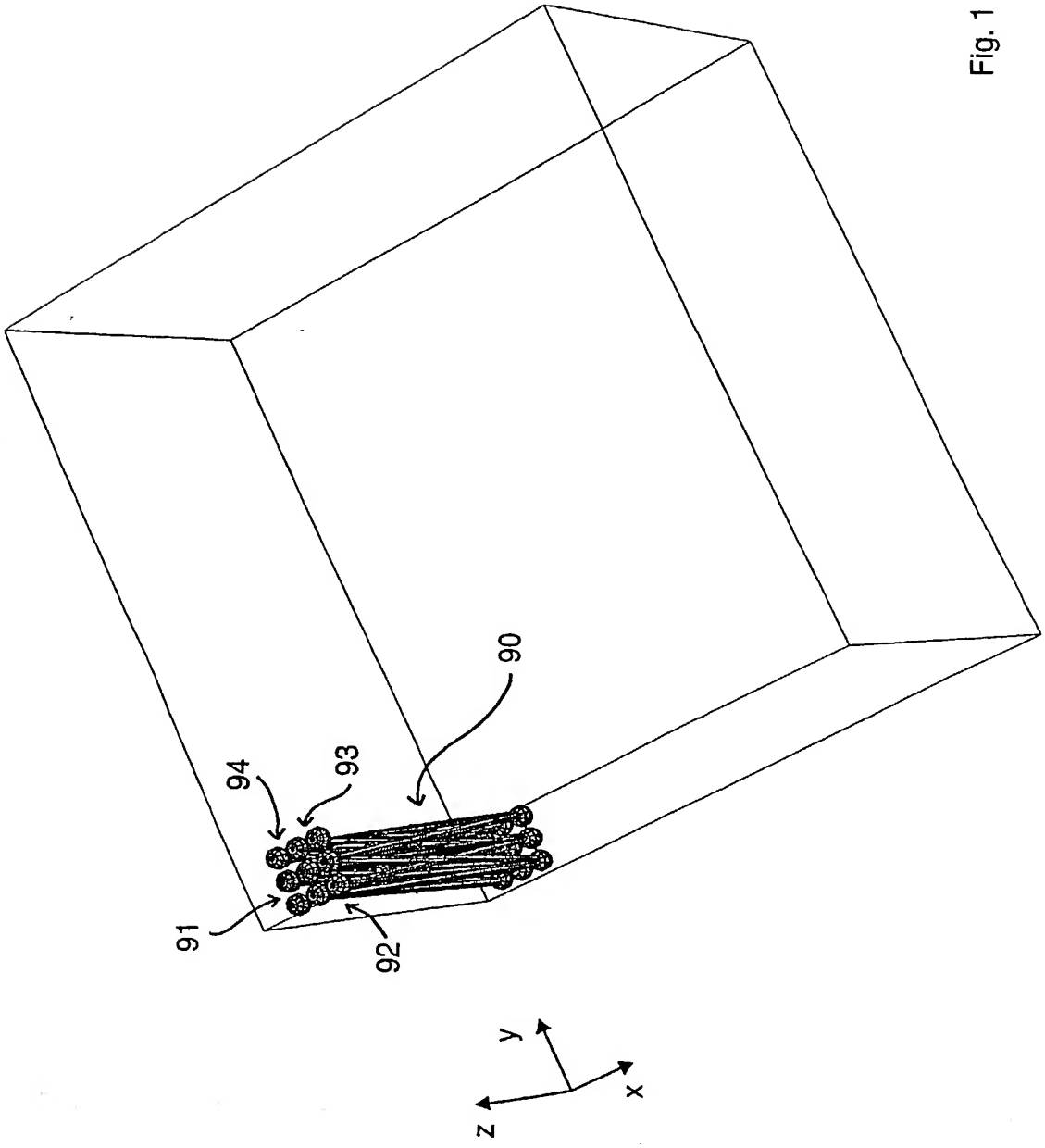

Fig. 1

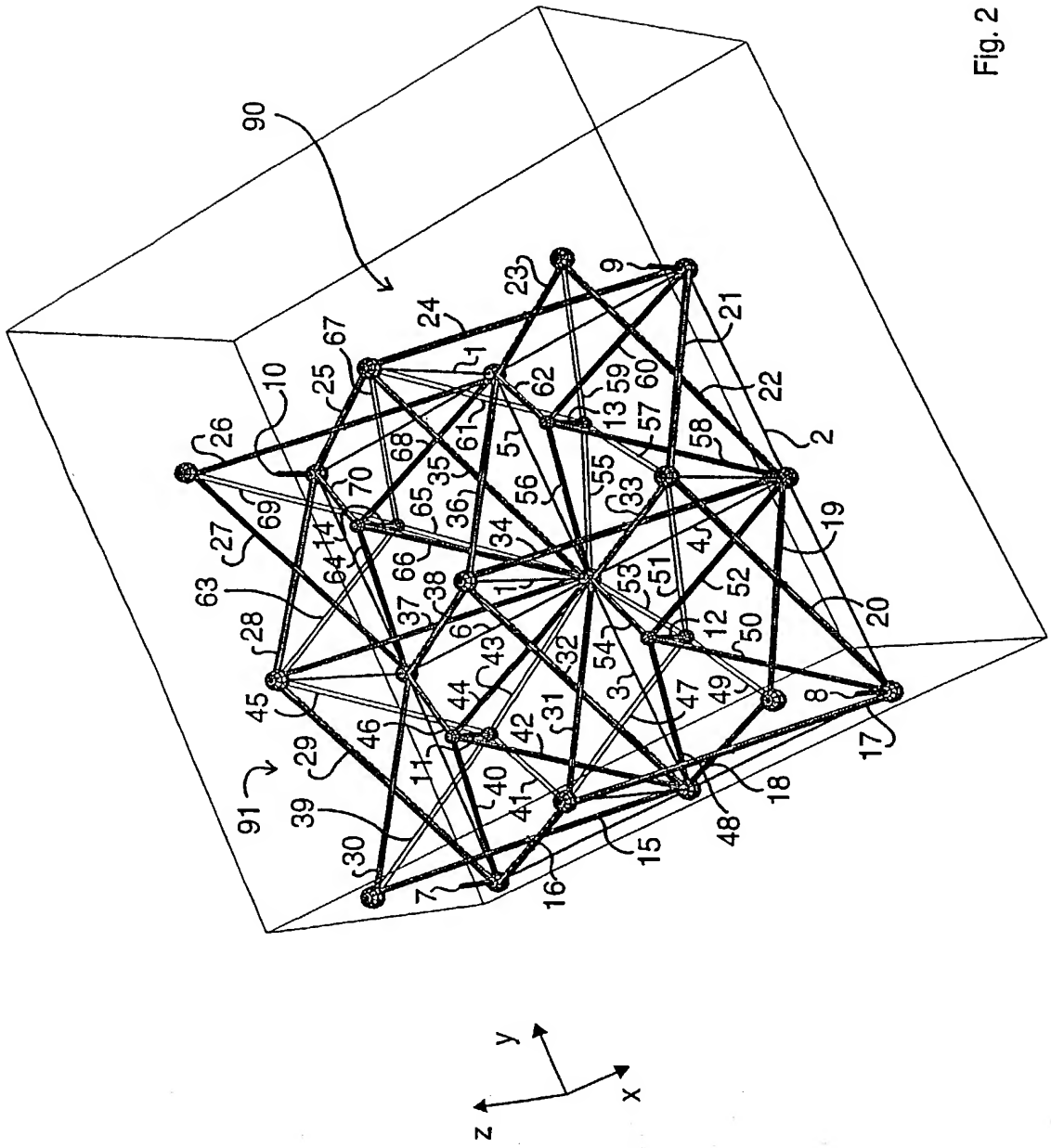

Fig. 2

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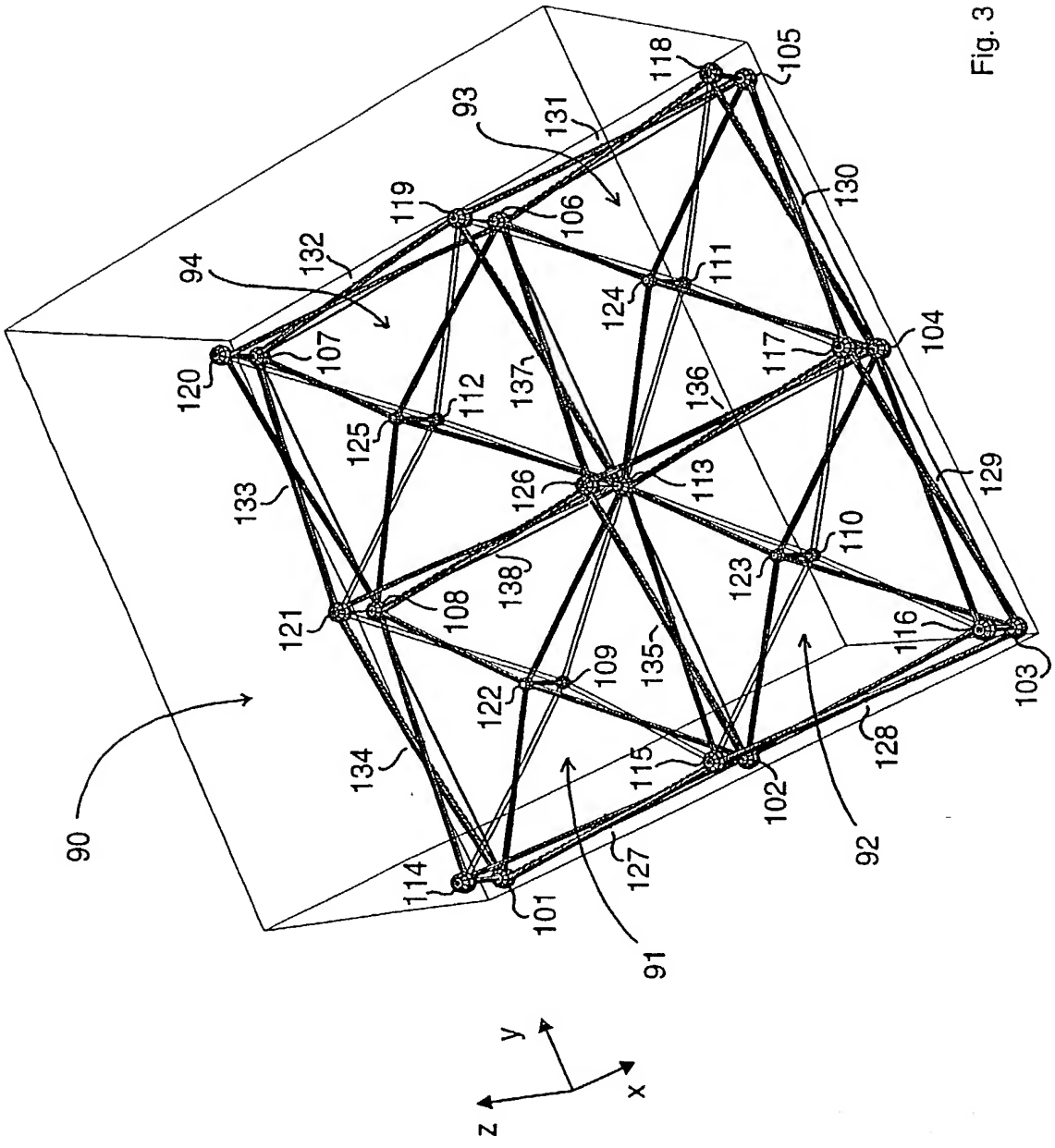

Fig. 3

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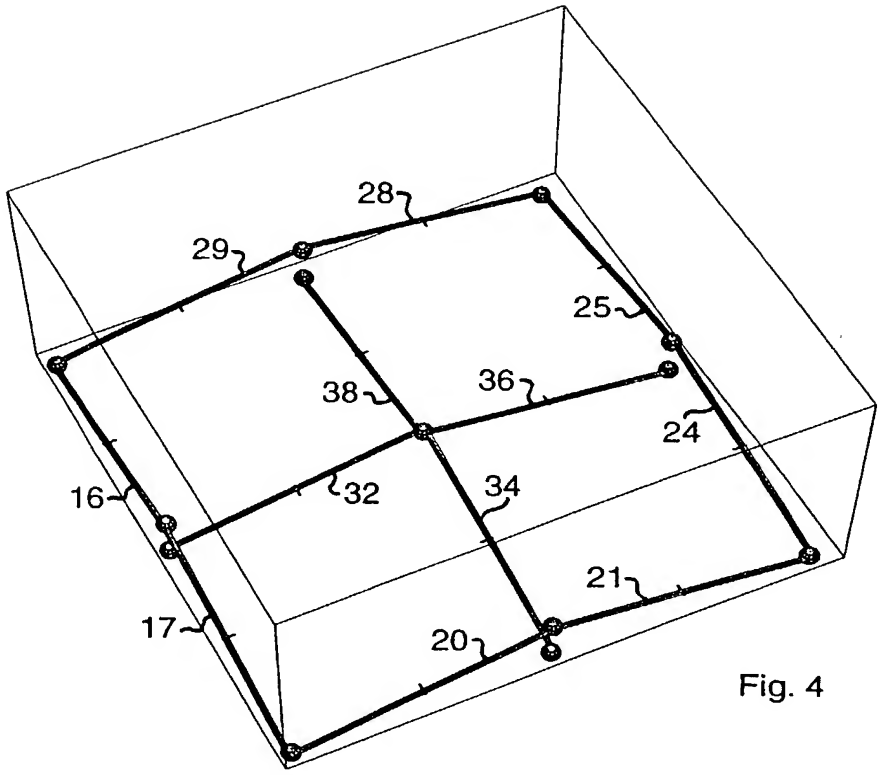


Fig. 4

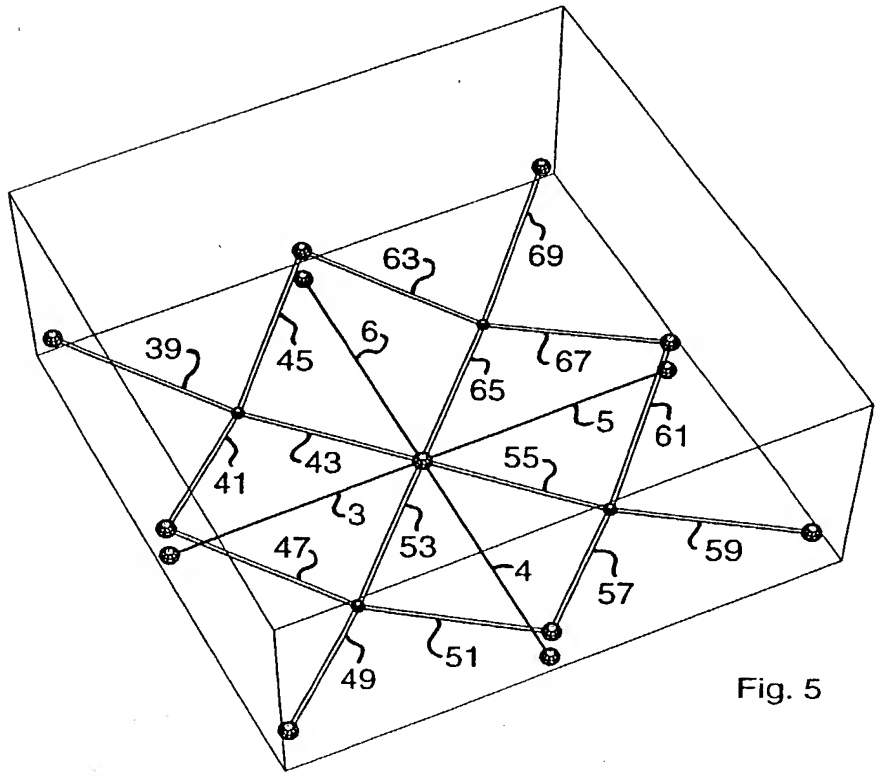
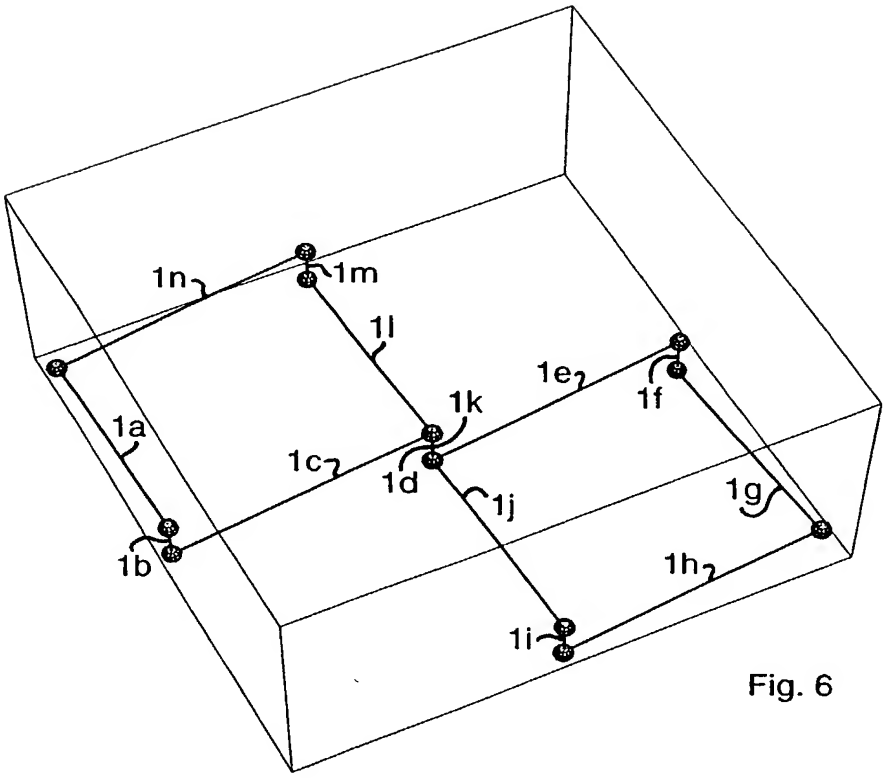


Fig. 5



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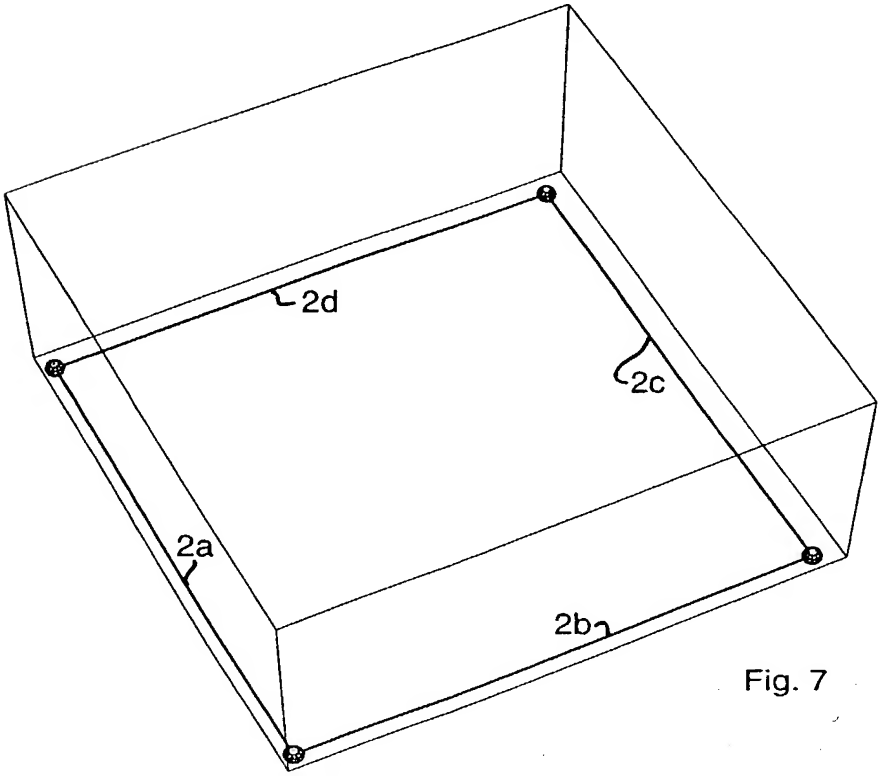

Fig. 7

10069705 . 10/069705

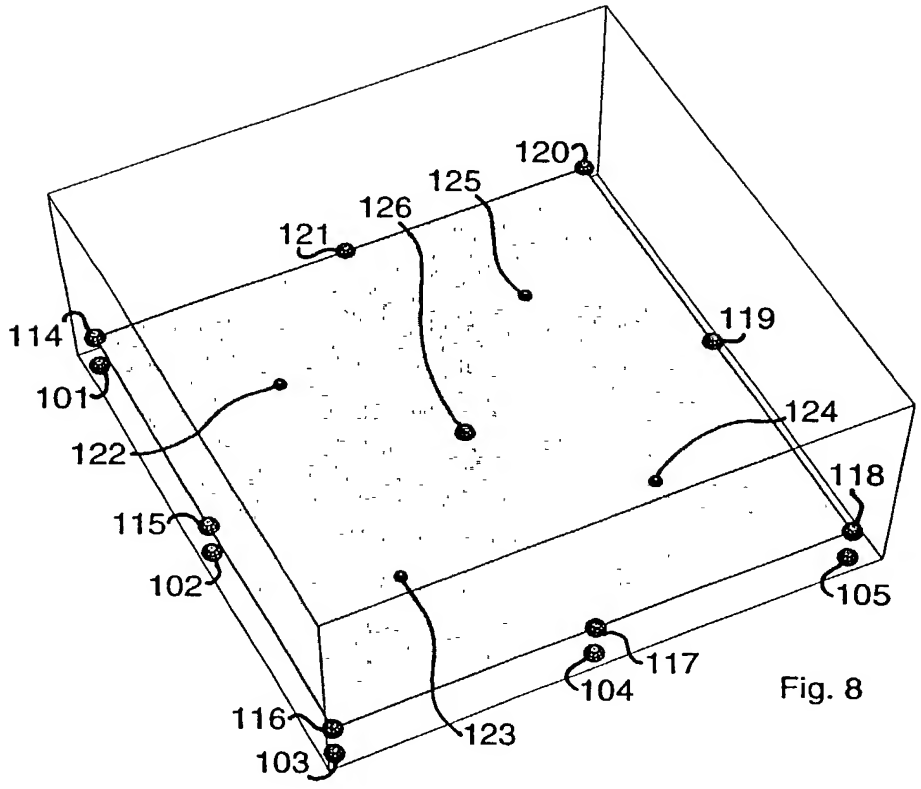

Fig. 8

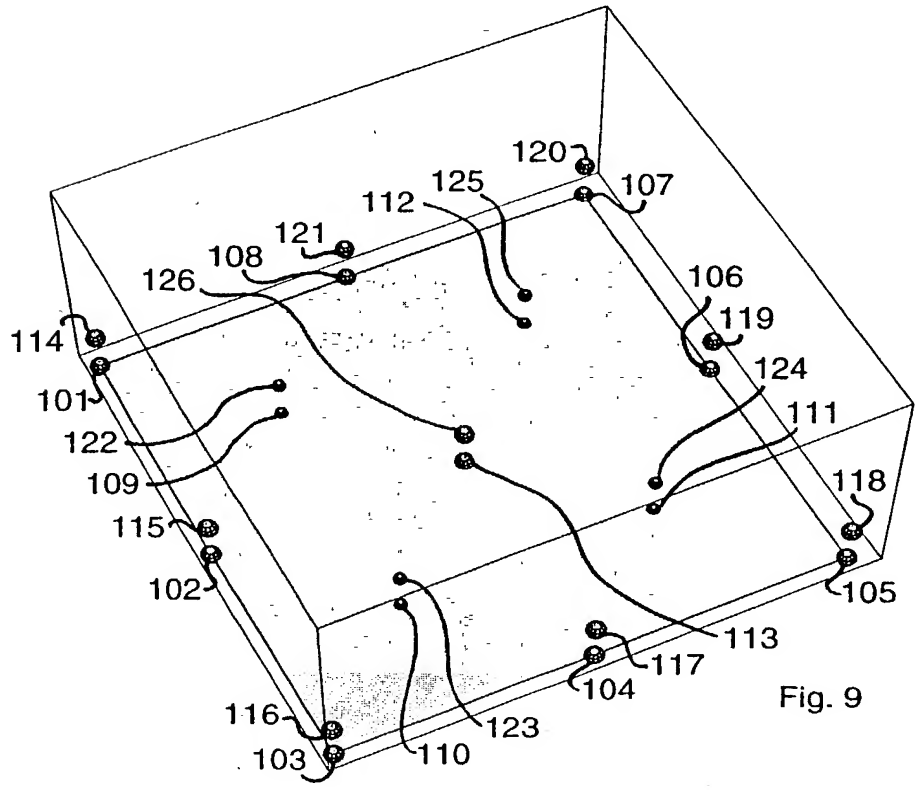

Fig. 9

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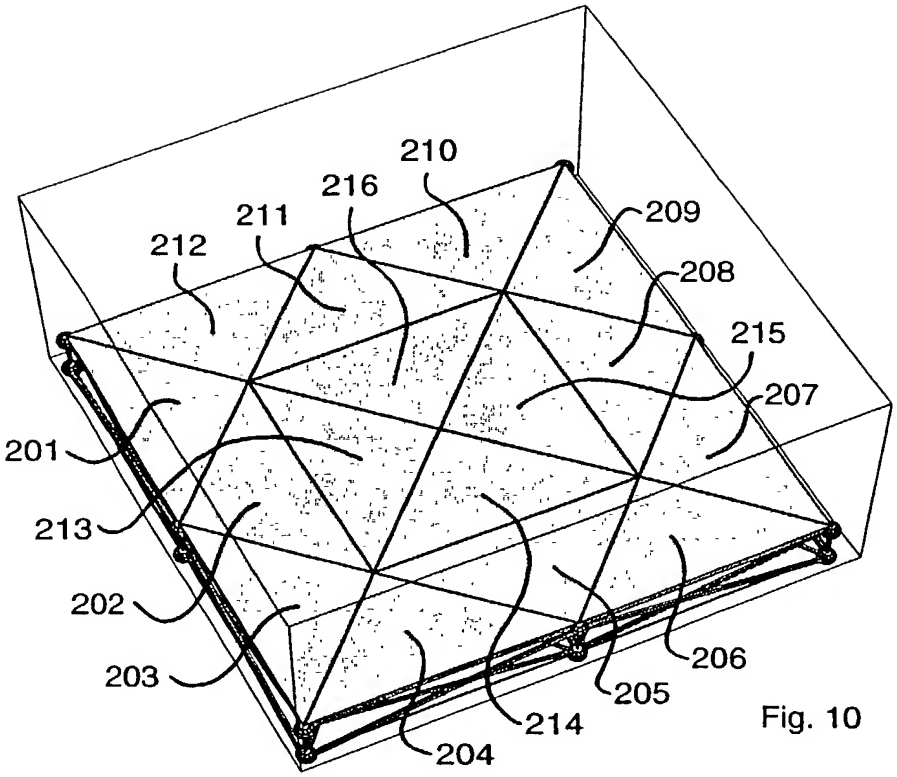

Fig. 10

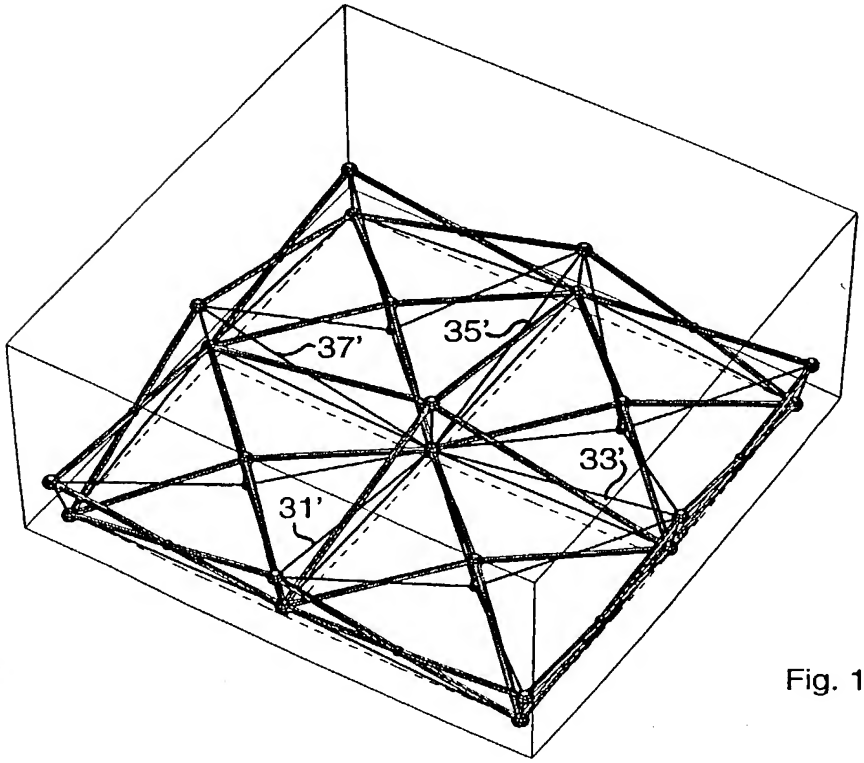

Fig. 11

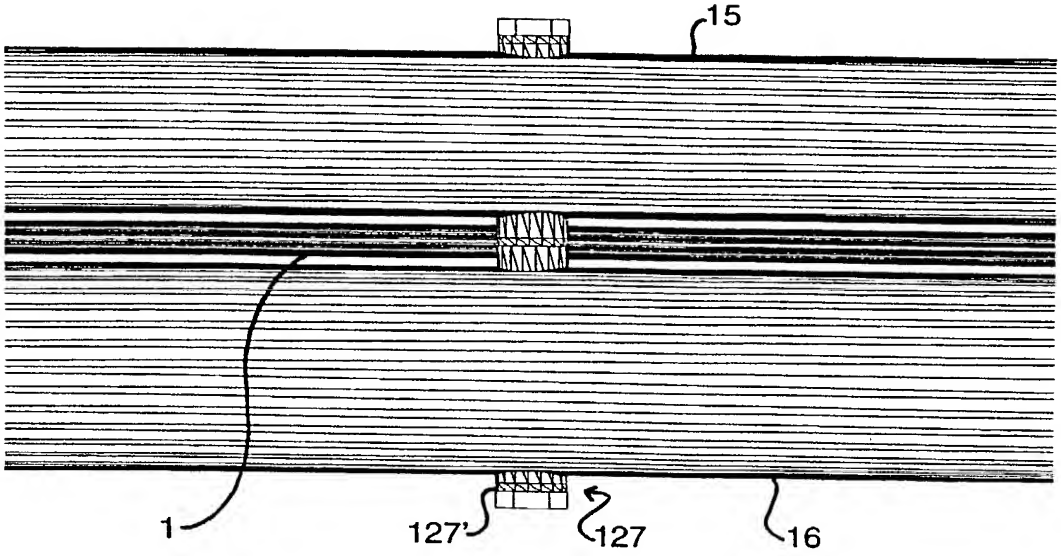

Fig. 12

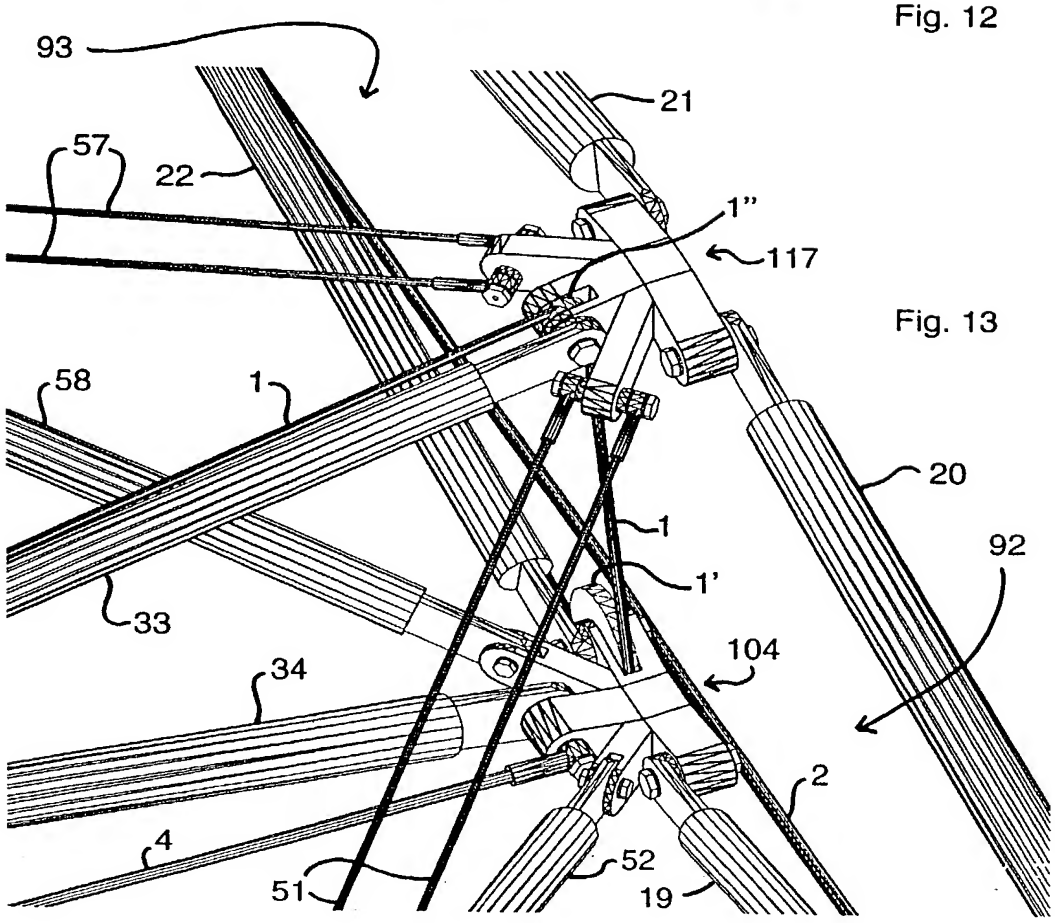

Fig. 13

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63) WITH POWER OF ATTORNEY

☐ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	4299
First Named Inventor	Gerhard Rueckert
COMPLETE IF KNOWN	
Application Number	/
Filing Date	
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

VARIABLE SUPPORT STRUCTURE WITH A MODULAR CONSTRUCTION, CONSISTING OF AT LEAST ONE COLLAPSIBLE STRUCTURAL MODULE

(Title of the Invention)

the specification of which

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) 08/09/2000 as United States Application Number or PCT International Application Number PCT/EP00/07728 and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
199 40 169.1	Fed. Rep. of Germany	08/25/1999	☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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FEBRUARY 25 2002

DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☒ Customer Number 021553

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PATENT AND TRADEMARK OFFICE

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-8

NAME OF SOLE OR FIRST INVENTOR: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]): Gerhard
Family Name or Surname: RUECKERT

Inventor's Signature: Gerhard Rückert
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NAME OF SECOND INVENTOR: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]) | Family Name or Surname

Inventor's Signature | Date

Residence: City | State | Country | Citizenship

Mailing Address

Mailing Address

City | State | ZIP | Country

☐ Additional Inventors are being named on the ____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

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